

Figure 1:

Cross-sectional view through the inverse opal backbone (blue) resulting from incomplete infiltration of silicon into the air voids of an artificial opal. After etching out the template, a fcc lattice of overlapping air spheres remain and additional air voids appear as triangular or diamond shaped holes on the surface of the cut. A tunable PBG is obtained by infiltrating this backbone with nematic liquid crystal (yellow) which wets the inner surface of each sphere (only one is shown in the figure).

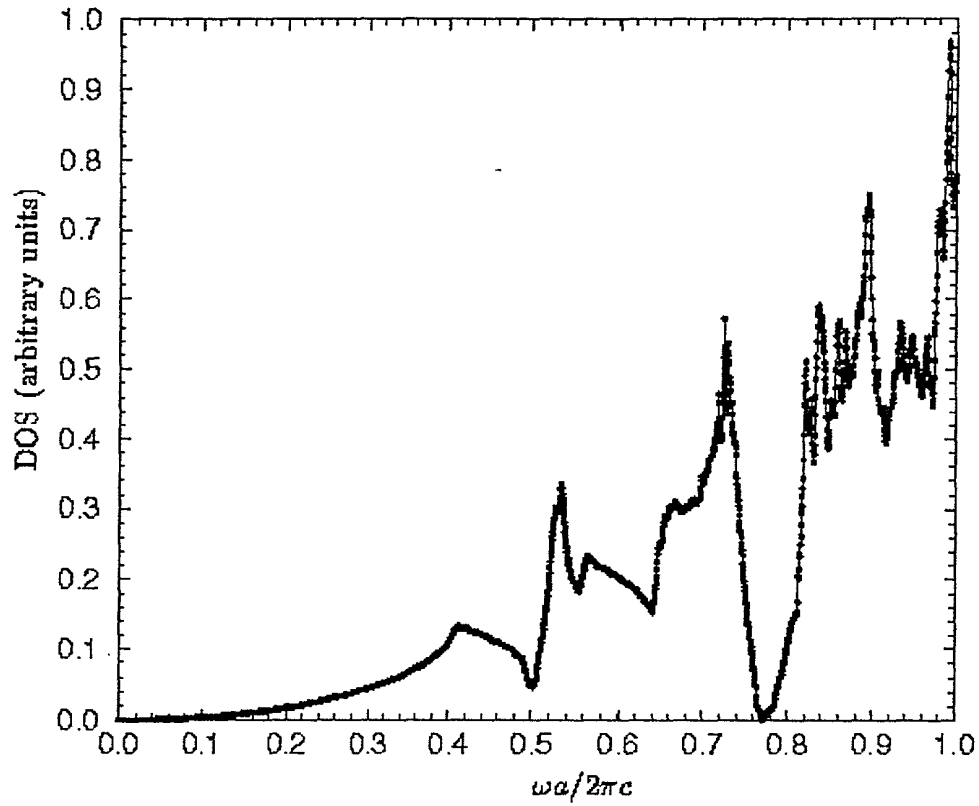


Figure 2: Total DOS for an inverse opal which is infiltrated with a nematic liquid crystal.

The nematic director is orientated along the $(0,0,1)$ axis of the inverse opal backbone.

The inverse opal backbone is made of silicon (24.5% by volume) which is infiltrated with the liquid crystal BEHA (36.8% by volume). The isotropic refractive index of silicon

is $n_{Si}=3.4$ and the principal refractive indices of BEHA are $n_{LC}^{\parallel}=1.6$ and $n_{LC}^{\perp}=1.4$.

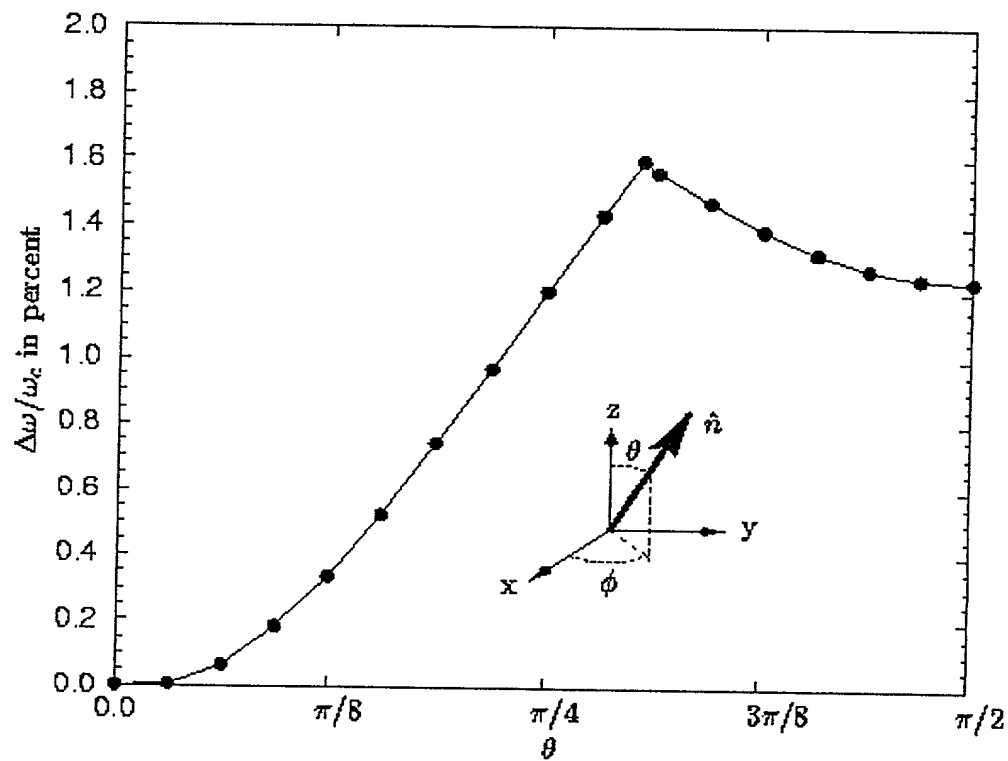


Figure 3: Dependence of the photonic band gap size for a silicon inverted opal infiltrated with the nematic liquid crystal (BEHA) on the orientation of the nematic director $\hat{n}(\phi, \theta)$ for fixed angle $\phi = \pi/4$. The volume fractions are the same as in Fig. 2.

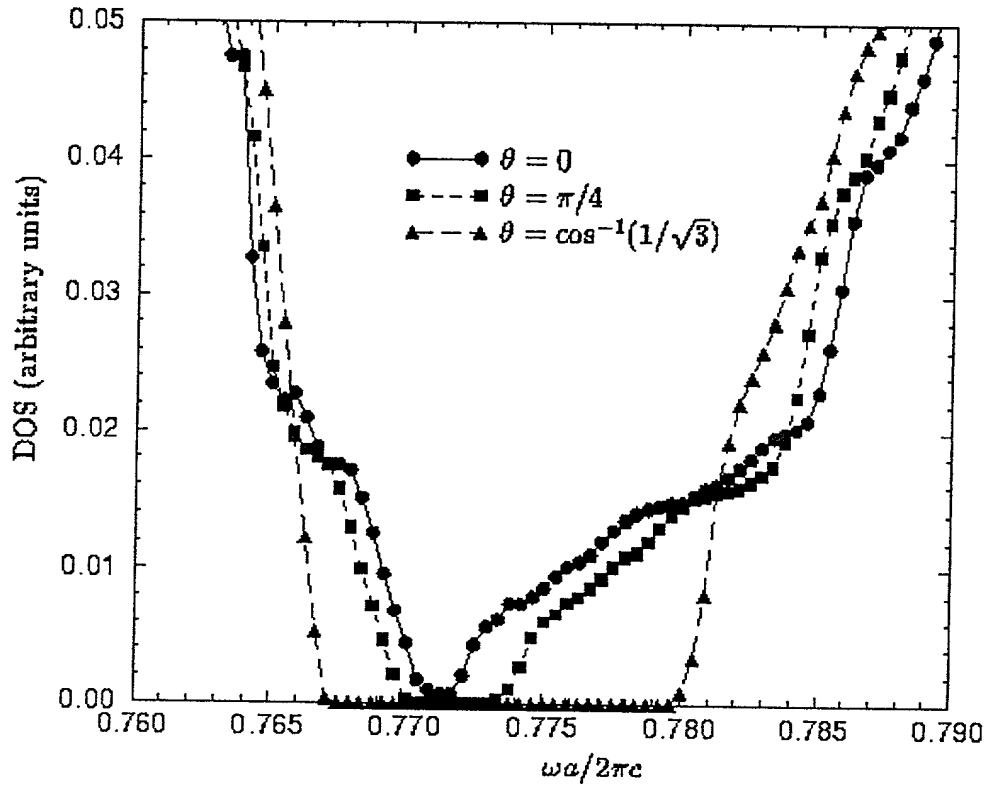


Figure 4: Total photon DOS for a silicon inverse opal which is infiltrated with the nematic liquid crystal (BEHA) for various orientations of the nematic director $\hat{n}(\phi, \vartheta)$. The angle $\phi = \pi/4$ is fixed and the volume fractions are the same as in Fig. 2. The PBG is closed for $\vartheta = 0$ but reaches a maximum value $\Delta\omega/\omega_c \approx 1.6\%$ relative to its center frequency ω_c for $\hat{n} = (1,1,1)/\sqrt{3}$.

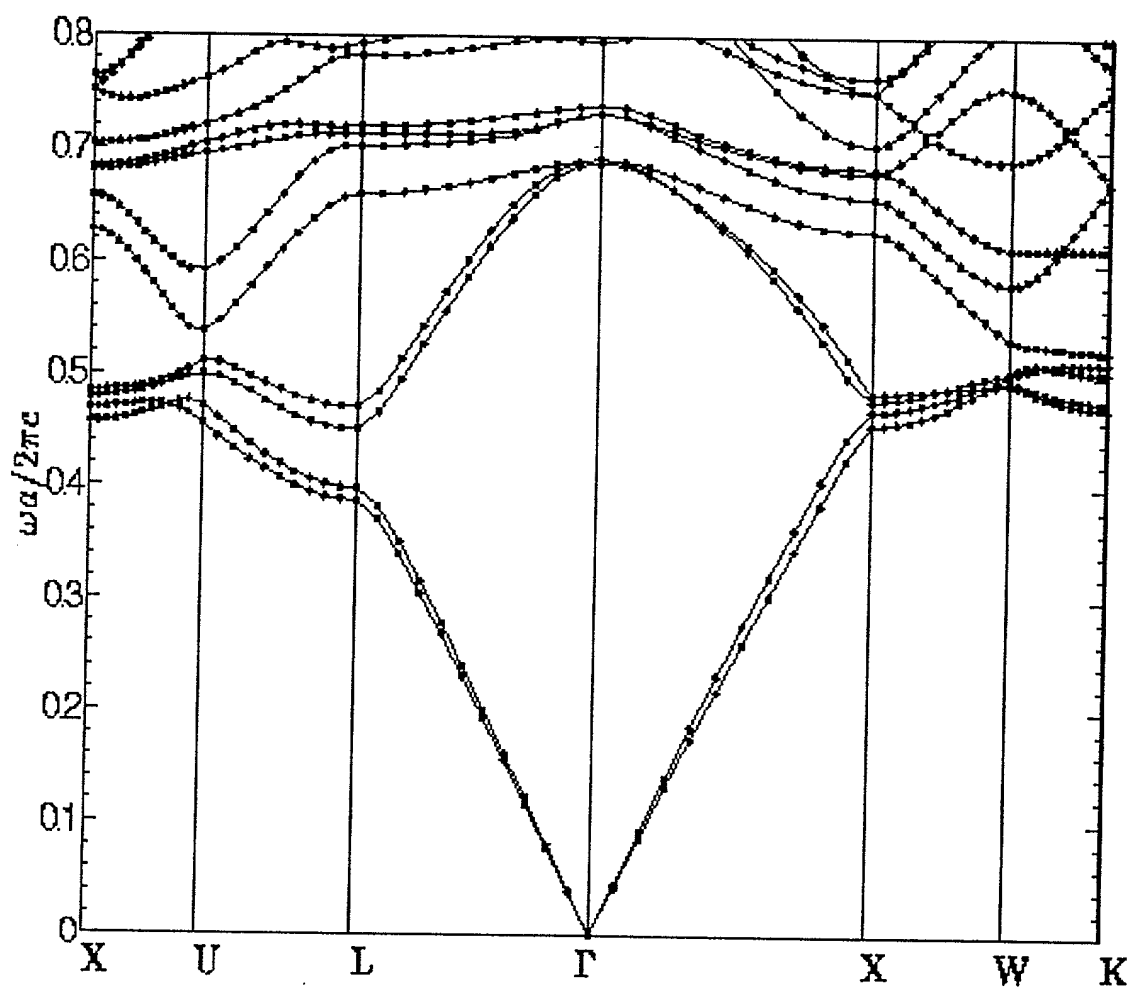


Figure 5. Photonic band structure of a silicon inverse opal which has been fully infiltrated with liquid crystal BEHA

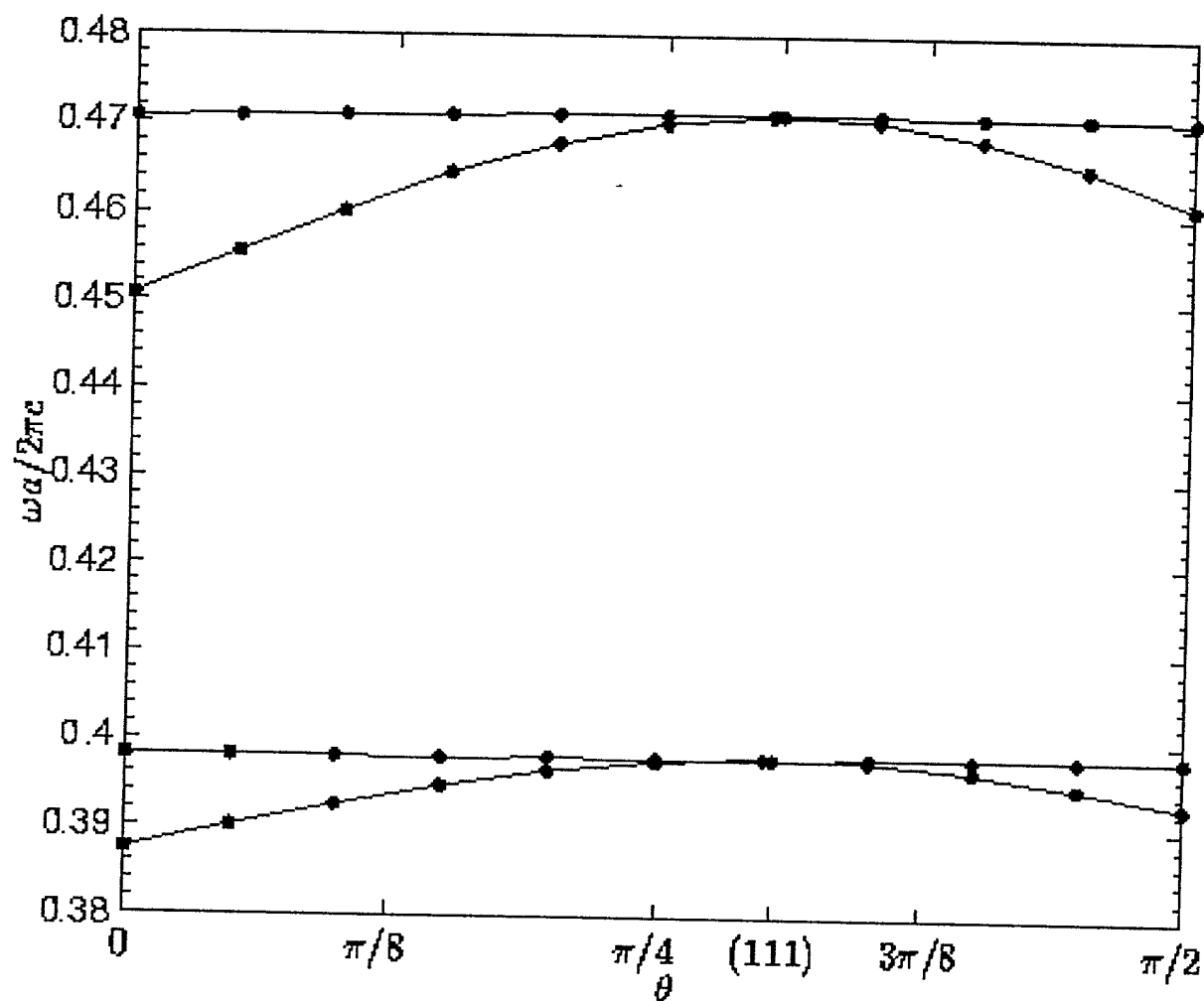


Fig 6. Variation at the L-point: Bands 1-4

Figure 7: Variation at the L-point: Bands 6-10

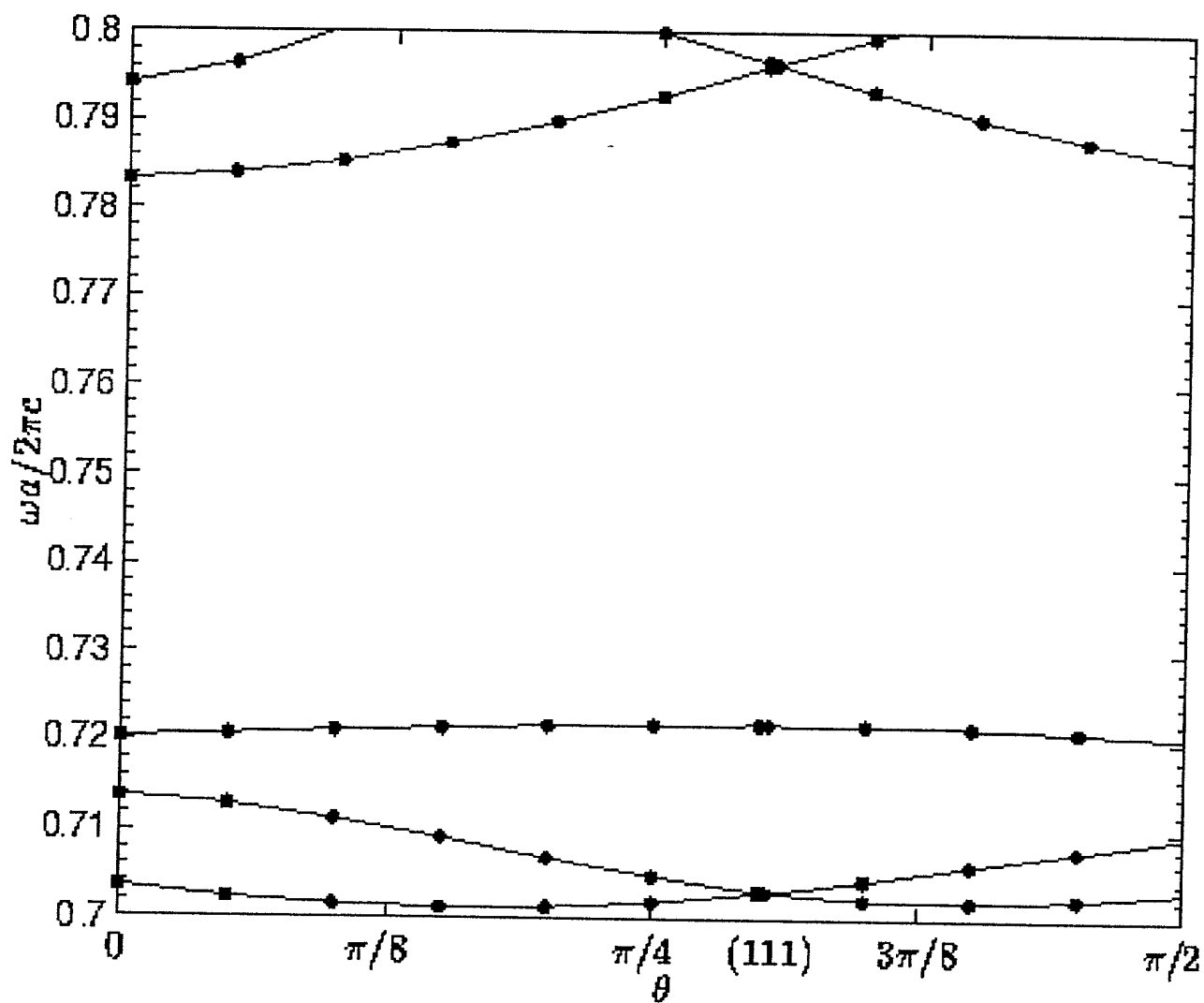


Figure 8: Variation at the X point: Bands 1-4

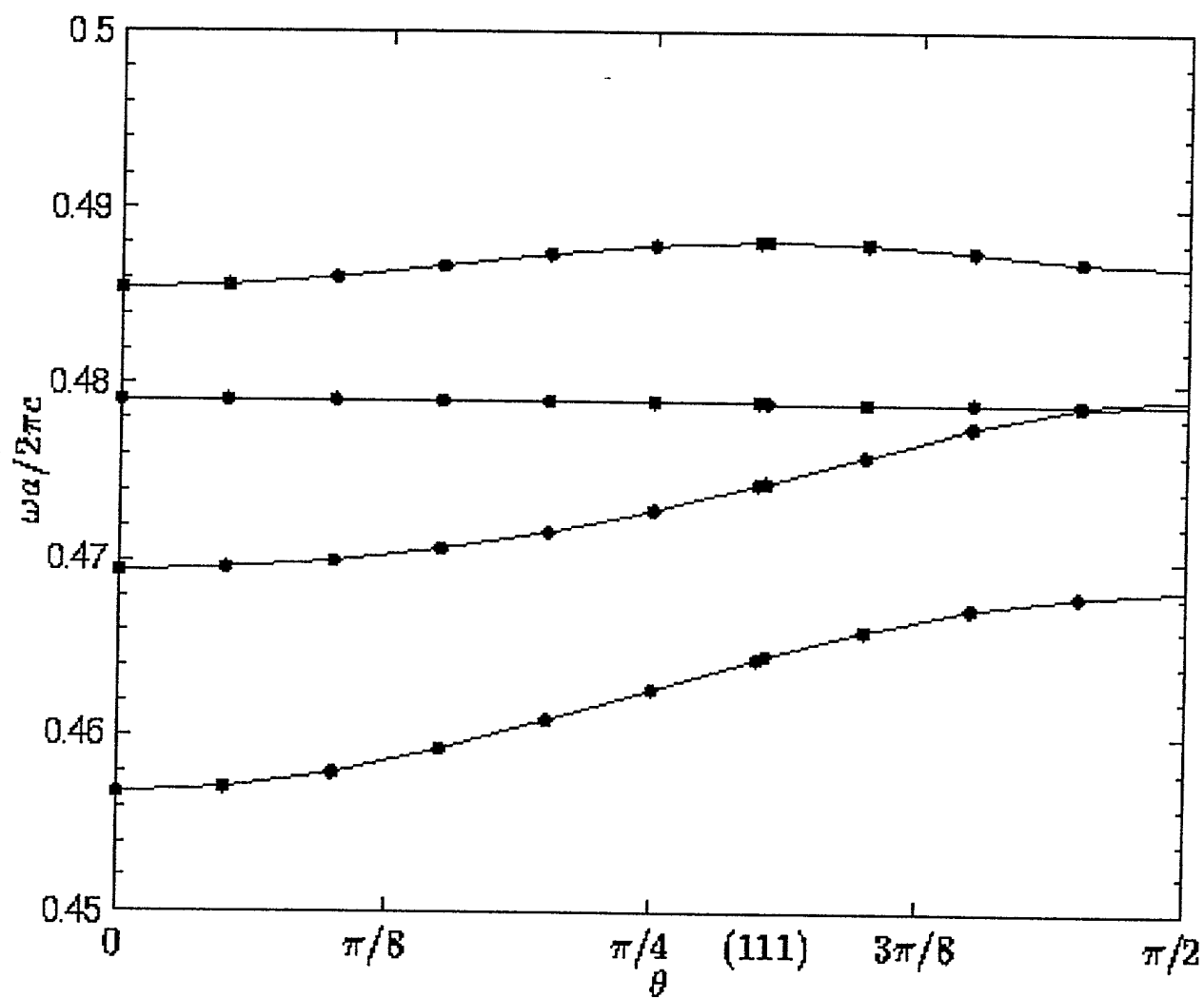
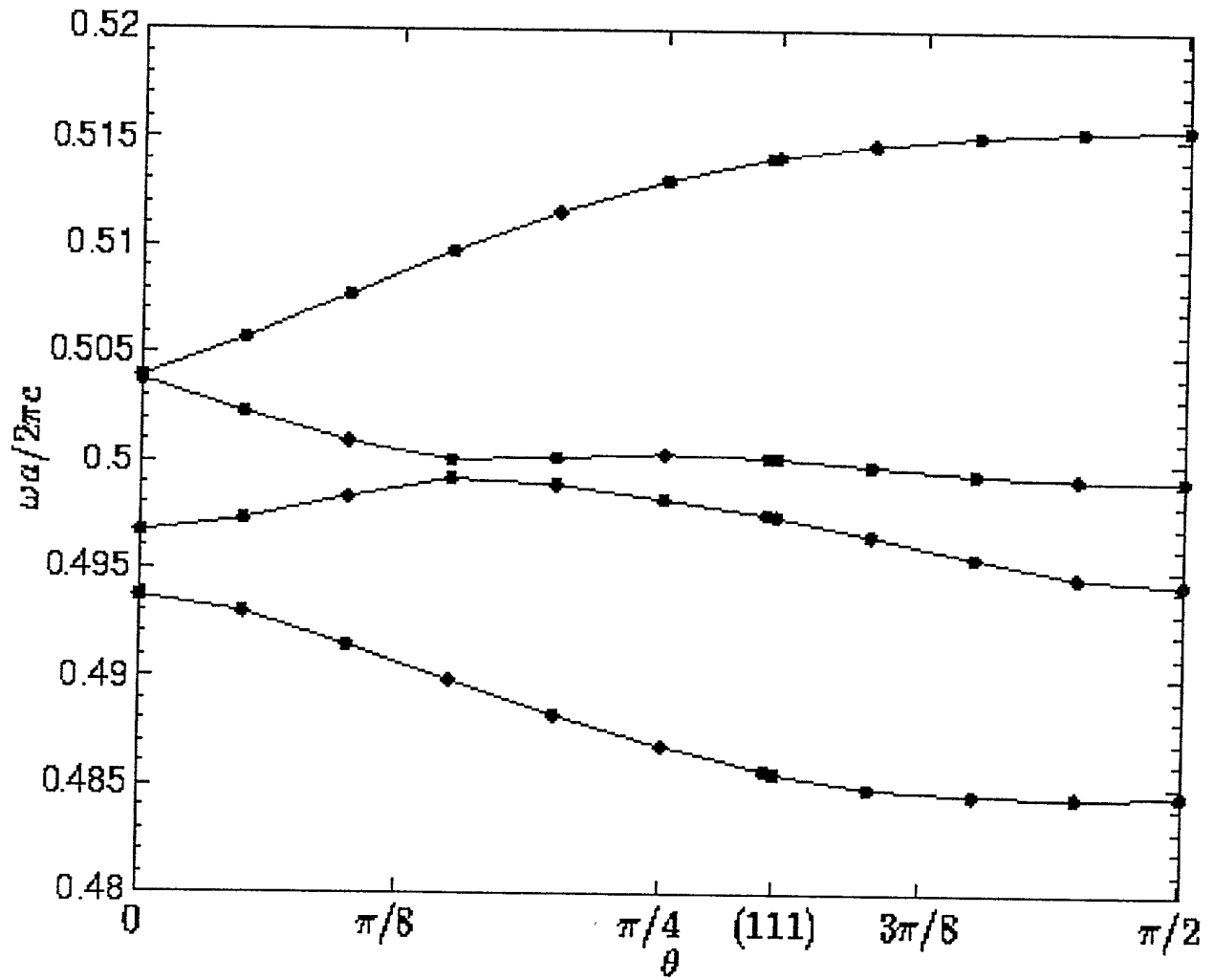


Fig 9. Variation at the W-point: Bands 1-4



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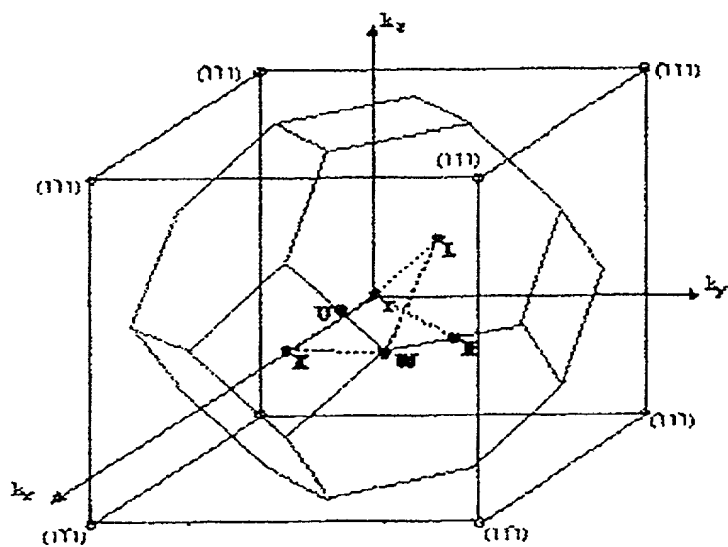


FIG. 10

F/G. 11

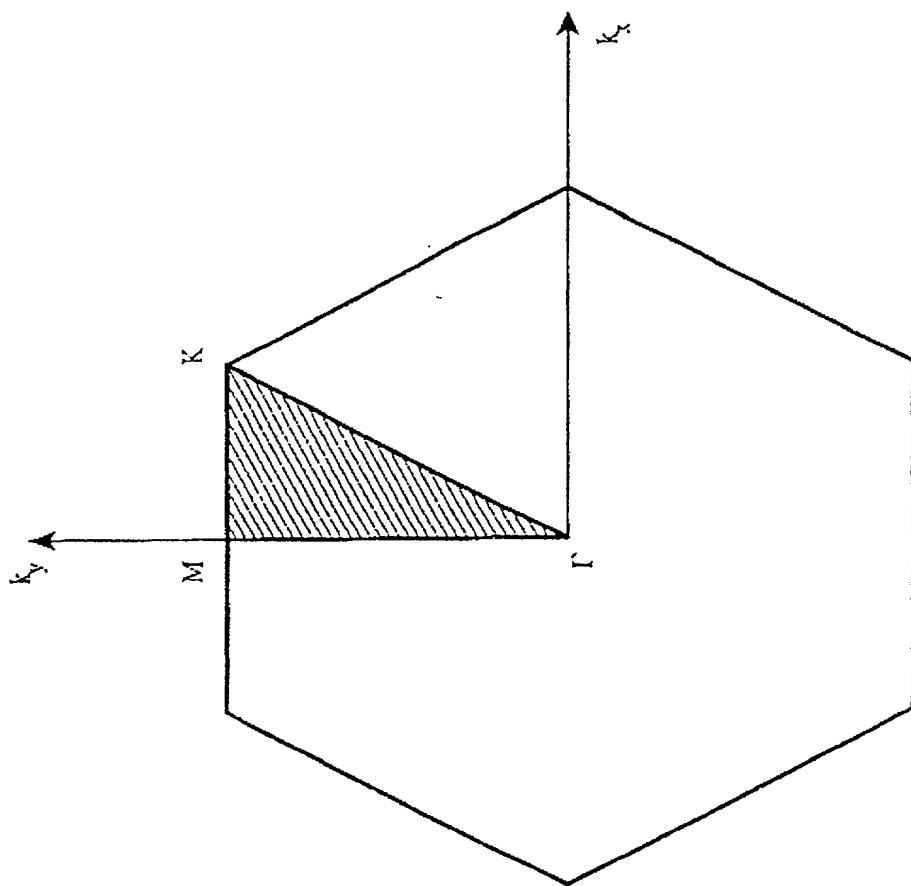


FIG. 12

FIG. 13

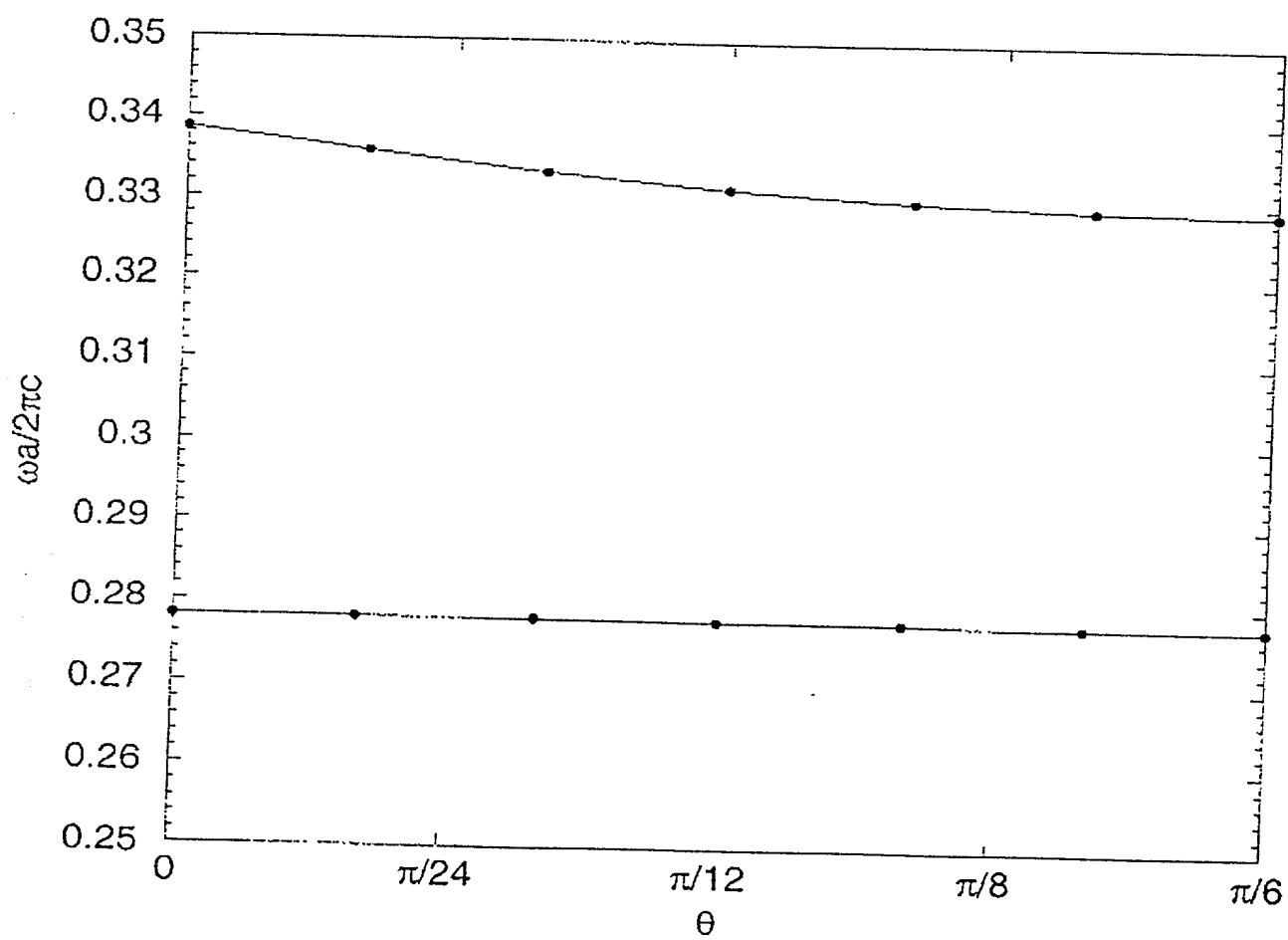


FIG. 14

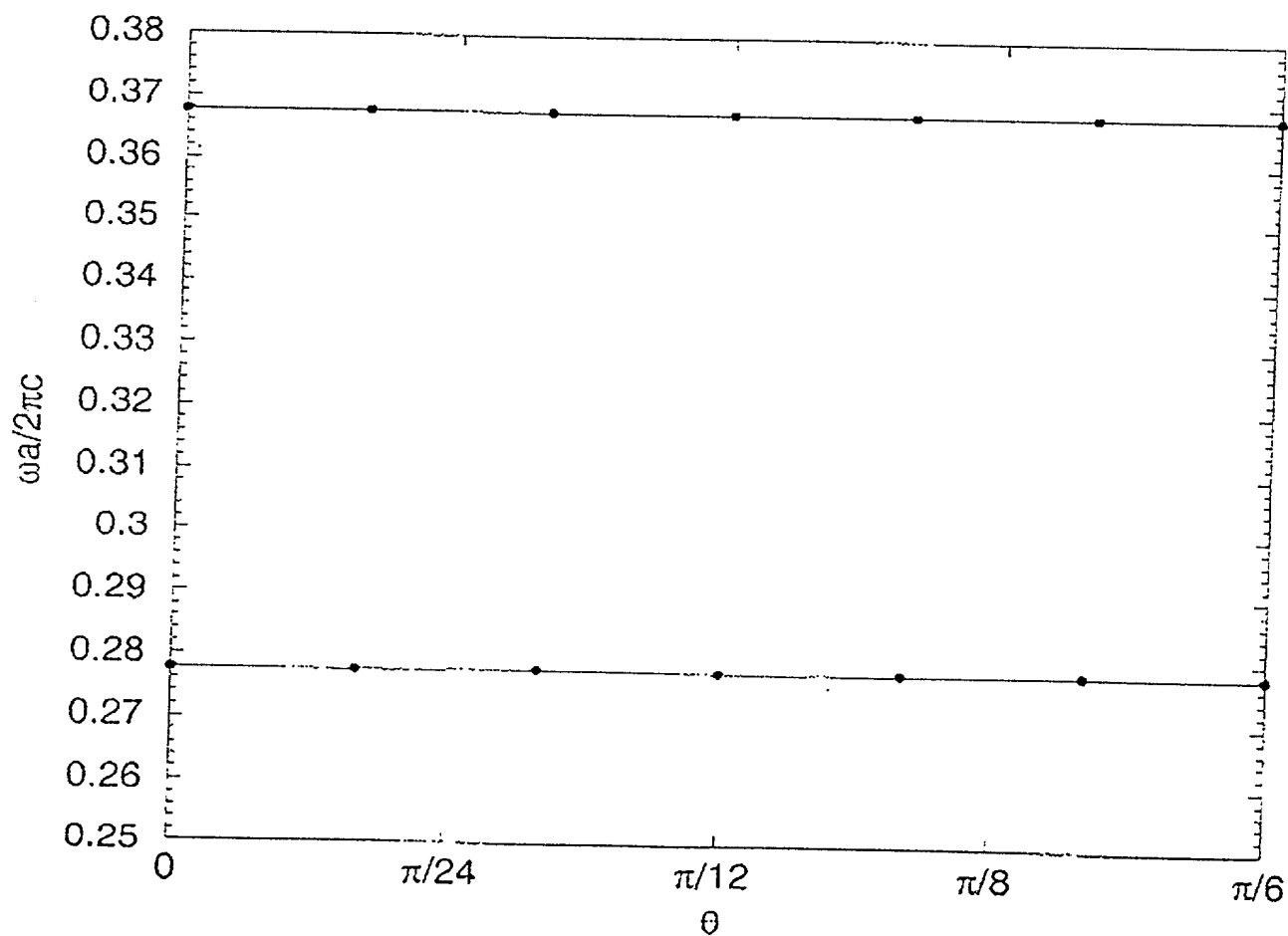


FIG. 15

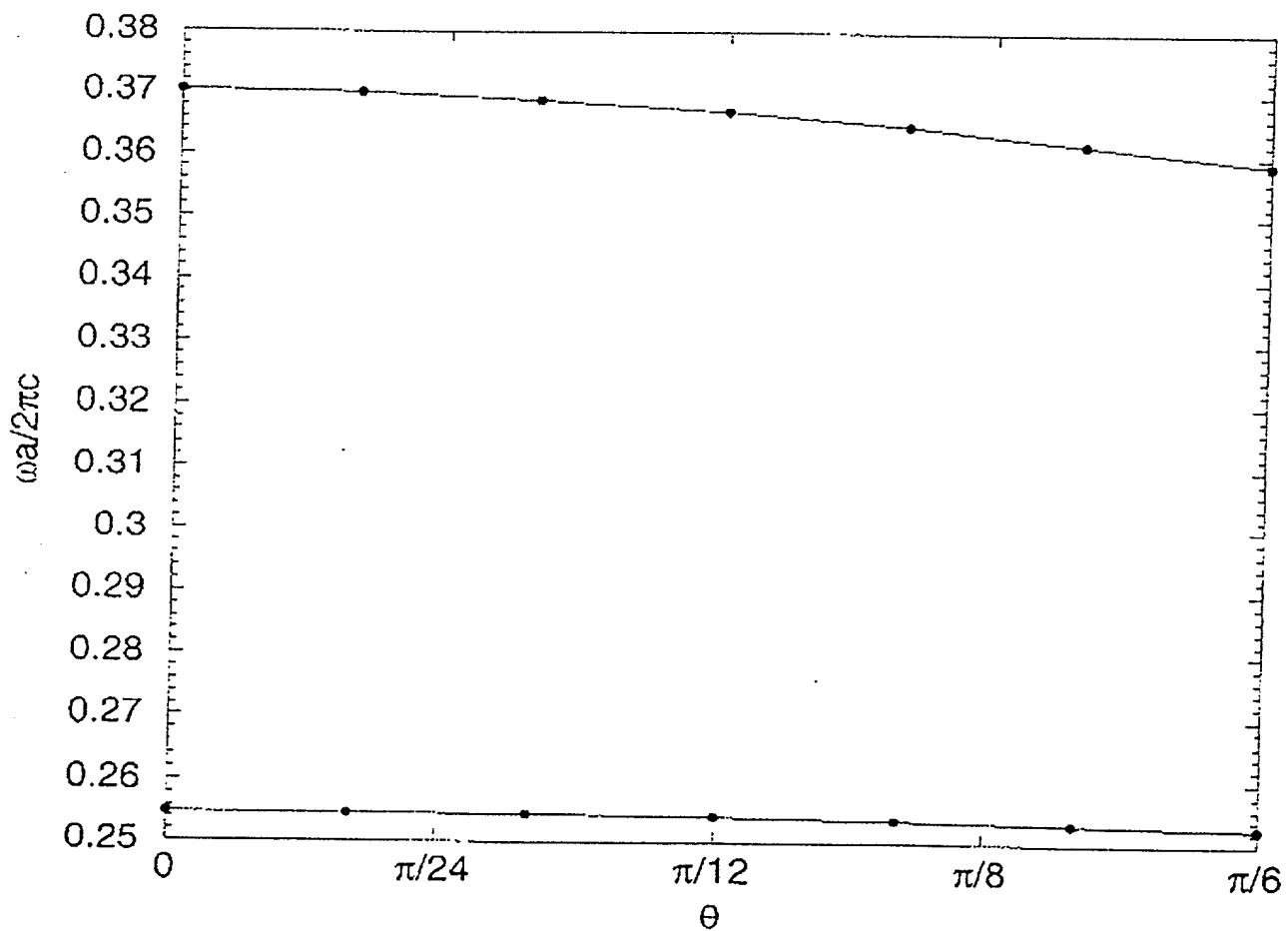


FIG. 16

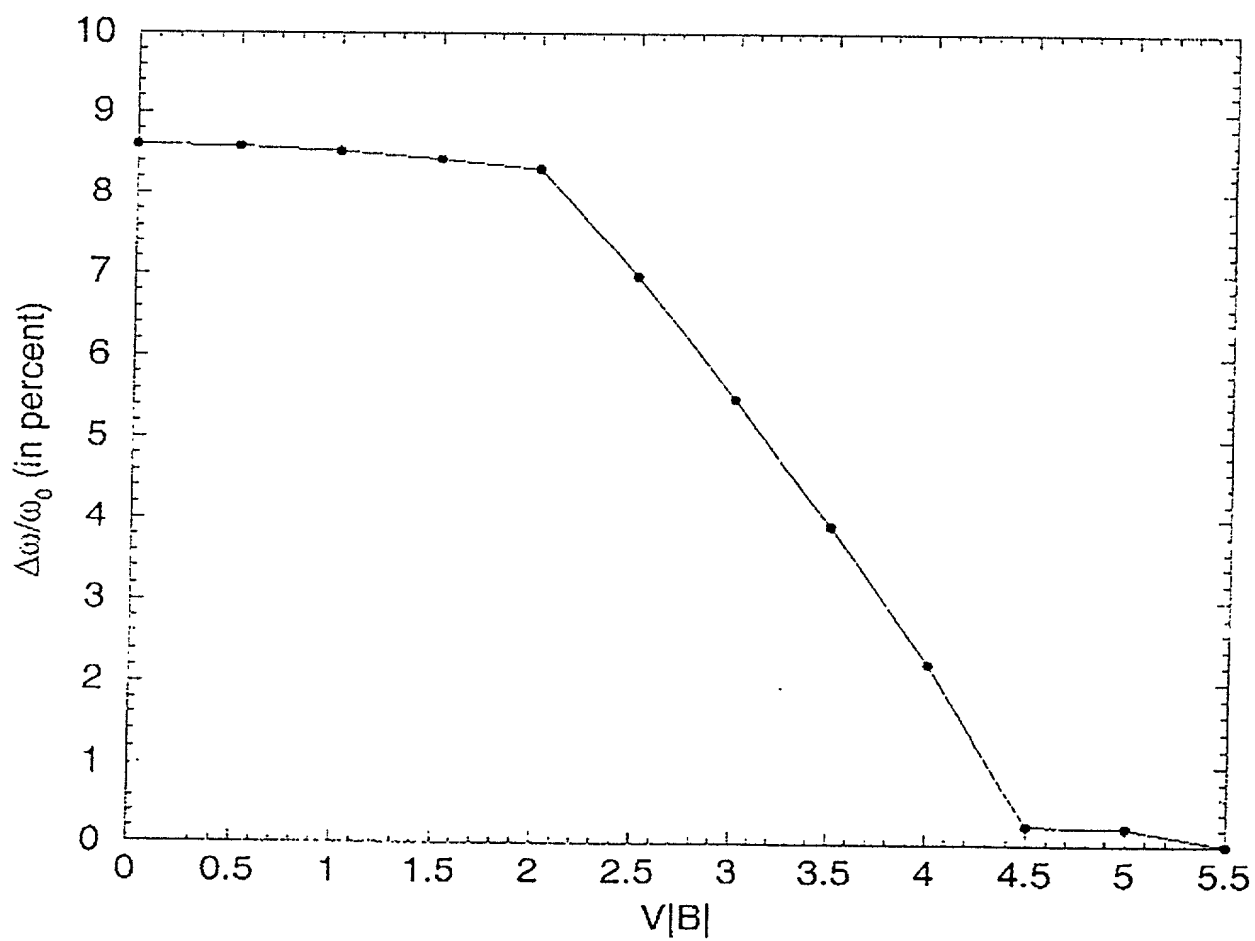


Fig. 17.

